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ABSTRACT

Using information drawn from research studies, the literature, and personal experiences, selected physiological, cognitive, and affective differences among 10- to 15-year-old middle school science students are illustrated. A rationale is presented for K-12 school organization based on human brain growth studies, with particular emphasis on middle school organization; implications for science curriculum and instructional practices based on these studies are suggested. It is indicated that the characteristics of middle school students be given high priority during examinations of middle school curricula and instructional practices. (Author)

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Some Considerations of Early Adolescents with Implications for Curriculum and Instruction in Science

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Introduction

Many school districts in Michigan currently have or will shortly adopt a middle school organization. These middle schools will house early adolescents in grades 6 to 8 rather than in the traditional 7-9 grouping associated with the junior high school. Therefore, we would like to spend a short time sharing with you some views about the middle school students you are or will be teaching, with implications for curriculum and instruction in science.

When we look at early adolescents, or "transecents" as they are sometimes called, that is, 10 to 15-year-olds, we find that they are not only unique as a group, but we also find that there are major physiological, cognitive, and attitudinal differences among them.

A. Physiological differences:

To illustrate physiological differences, all one has to do is to observe children entering a middle school. The tremendous variation in physical development is quite obvious. Virtually all of these students are undergoing significant physical changes, but not at the same rate (Tanner, 1962). One middle school teachers has pointed out:

> "The first two periods of the day, I teach seventh-graders: children; the last three periods of the day I teach accelerated biology to ninth-graders: they are growing adults."

Research studies have shown that middle school students are concerned about physical changes and the differences resulting from them (Angelino and Meck, 1955; Faust, 1960; Simmons, et al., 1973). This is true not only for the "children" but also for the "growing adults." Coursework in human biology is important for these students, with a high degree of interest and motivation. A unique laboratory study experience we recently heard about was one on "zits," or acne, developed and conducted by an eighth-grader.

We suggest that one function of the middle school should be to reduce anxiety in students by helping them accept physical change as normal. This would involve pointing out what changes will take place, and that different rates of growth are <u>not</u> abnormal.

This is not as difficult as it sounds. Our experiences with middle school students have shown that they were extremely interested in their bodies and its development. By gathering data, for example, of height, weight, arm length, head circumference, etc., these students gained experiences in measuring, using the metric system, graphing, ratios, proportions, averaging, etc., while learning a considerable amount about their bodies and development.

As you probably suspect, this activity was a cooperative effort on the part of three teachers: the science teacher, the math teacher and the health teacher. We were attempting to cross the barrier of science in the science class, math in the math class and health in the health class.

B. Cognitive Differences:

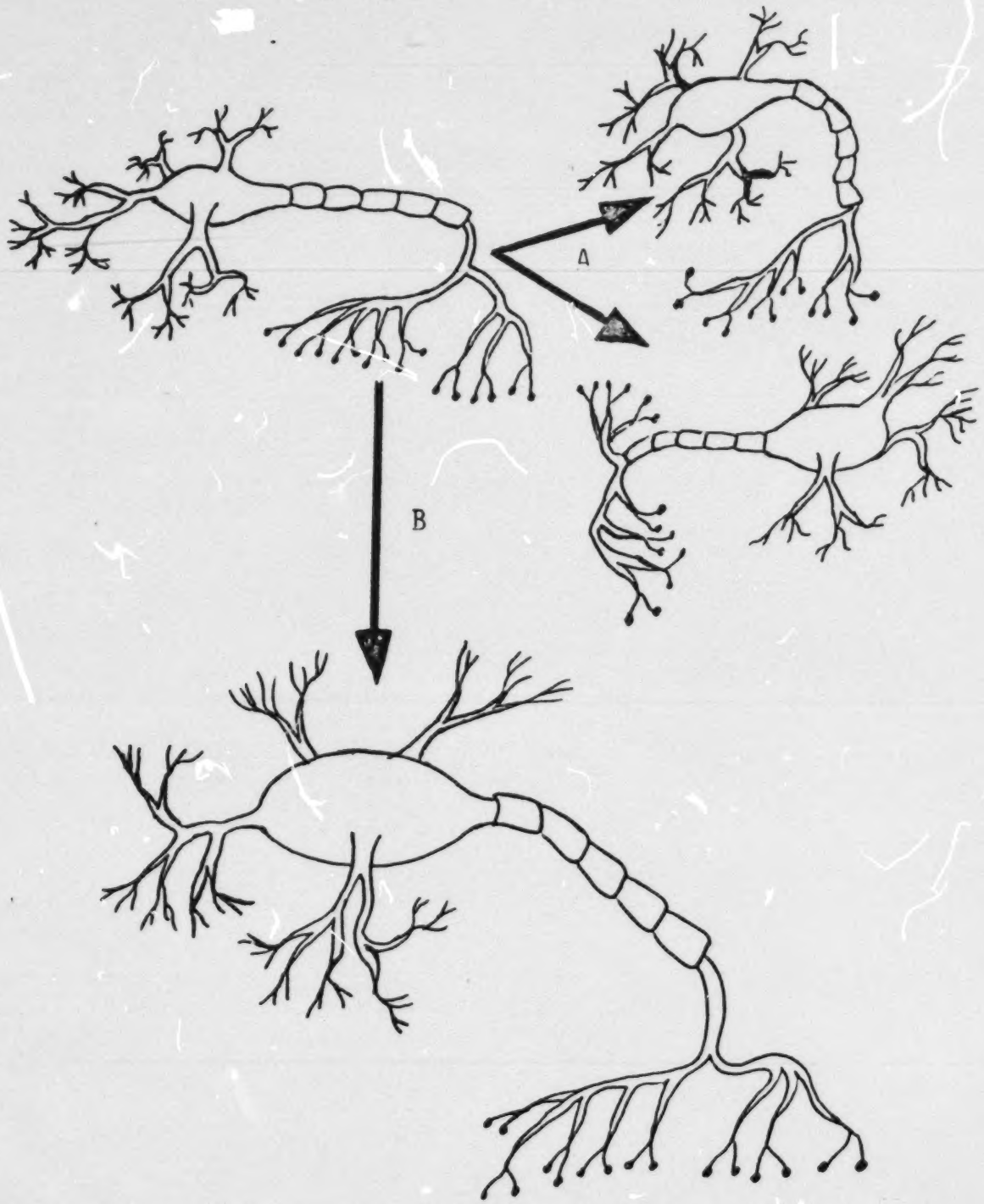
Let us now look at some cognitive aspects of transecents. In science classes we usually stress what science is and what scientists do. Many teachers and curricula have tried to make "scientists" out of these students, yet the majority of them cannot do the formal reasoning required of the scientist. That is, they cannot do reasoning required for proportional thinking, combinatorial thinking, or solve problems requiring separation and control of variables (Abramowitz, 1974; Karplus, et al., 1975; Linn and Levine, 1976). A majority of them have difficulty with concepts such as density, floating and sinking, levers, graphing, and other concepts dealing with abstract thinking. However, these students can deal with problems for the most part involving conservation of volume, length and mass; they can classify and group facts into concepts.

Some exciting research related to the cognitive development of early adolescents is that reported by Herman T. Epstein, Professor of Biology at Brandeis University.

Human biologists know that the formation of human brain cells ends before the second year of life. However, these cells continue to "grow" well into early adulthood. [Transparency 1 here]. When we speak of growth, we are not speaking of an increase in numbers, that is, we are not speaking of one cell dividing mitotically into two cells. By growth we mean an increase in cell size, and therefore an increase in brain mass.

Transparency 1

BRAIN GROWTH



A- Increase in numbers (mitotically)

B- Increase in mass

Epstein (1978) presents data indicating [Transparency 2 here] that this increase in brain mass does not occur on a continuum, but occurs in discrete periods of human life. These periods alternate with periods when there is little or no brain growth.

Epstein's data reveal that in perhaps 85% of the children between ages 12 to 14, the brain ceases to grow. Then there is a spurt between ages 14 to 16. Epstein believes that novel intellectual inputs are most effective during these periods of active brain growth, or spurts.

There are predictions that brain growth spurts correlate in age with learning capacity. A new word thus appears in the educational literature, phrenoblysis (Epstein, 1974), that is, correlated brain/mind growth spurts. The exciting research potential for this data lies in testing correlational studies with Piagetian stages of intellectual development. [Transparency 3 here] As you can see, there is a similarity in ages of brain growth spurts and Piaget's sensori-motor, pre-operational, concrete operations, and formal operations stages of intellectual development.

At the present time, there is no Piagetian stage corresponding to the age 14 to 16 brain growth spurt. However, there is a recent report by Patricia Arlin (1975) that there is a fifth stage of intellectual development, which she calls "problem finding" to differentiate it from Piaget's fourth stage of "problem solving." Arlin's preliminary data indicate that the "fifth stage" can be found in both sexes

STAGES (PERIODS) IN BRAIN MASS INCREASE

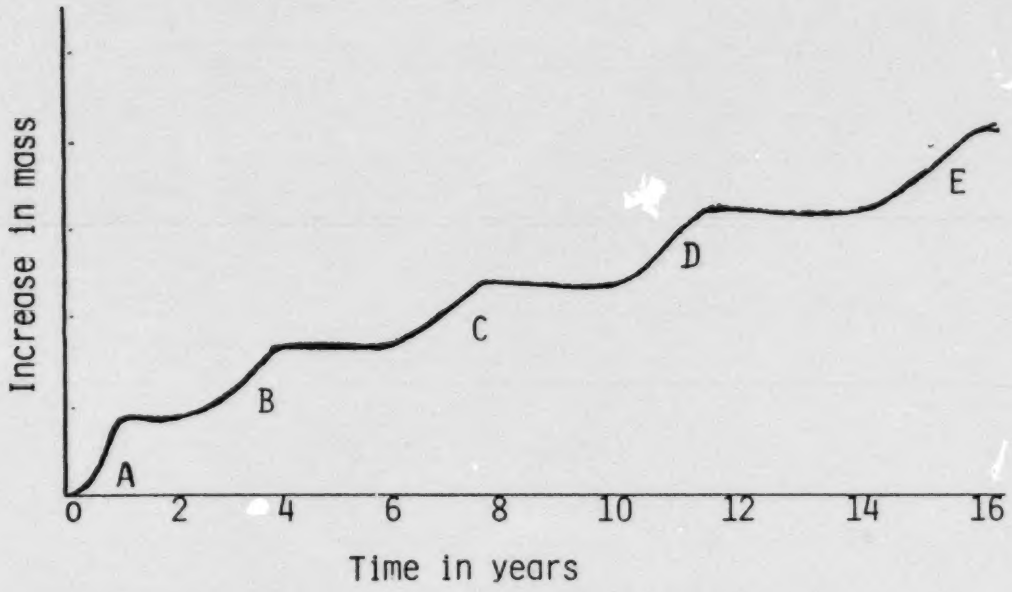
A 3-10 months

B 2-4 years

C 6-8 years

D 10-12 years

E 14-16 years



Transparency 3

PHRENOBLYSIS

EPSTEIN	PIAGET
3-10 months	1-18 months (sensori-motor)
2-4 years	2-4 years (pre-operational)
6-8 years	7-11 years (concrete operations)
10-12 years	11-15 years (formal operations)
14-16 years	?

of young adults but cannot be found in children age 13 and younger.

In a lighter vein, the work of Epstein might explain why a very experienced eighth-grade teacher told our student teachers that eighth-grade kids, kids between the ages of 12 and 14, were the most difficult to teach in the middle school. The teacher said: "We might as well turn them out to pasture for a year and let them grow!" Maybe some of you have the same feelings about eighth-graders.

Epstein's work has some important implications for middle school organization and curriculum.

1. Middle School Organization-

When we look at current middle school organizational practices, we find little consistency from district to district. We have found that the 10- to 15-year-year-olds, for example in North Carolina, are housed with at least 26 different grade configurations. [Transparency 4 here] These are only some of the patterns in current practice: grades 7 to 9, 6 to 9, 6 to 8, 5 to 8, 5 to 7, and 4 to 8. Each of these patterns is called a middle school, and in some cases a junior high school.

Studies have shown that 6th-graders are more like 7th-graders because of the early onset of puberty in most 6th- and 7th-graders, while 5th-graders behave more like children than adolescents. Ninth-graders are more like 10th-graders in terms of physical, social, emotional and intellectual maturity (Ducas, 1963; Creek, 1969; Myers, 1970). These

Transparency 4

MIDDLE SCHOOL ORGANIZATION

AGE	GRADE								
2									
3	preschool								
4									
5									
6	1								
7	2								
8	3								
9	4							4	4
10	5					5	5	5	5
11	6		6	6	6	6	6	6	
12	7	7	7	7	7	7	7	7	
13	8	8	8	8	8			8	
14	9	9	9						
15	10								
16	11								
17	12								

studies are usually cited in support of the 6 to 8 organization of the middle school.

If we examine Epstein's data, 5th-, 6th-, and 7th-graders are alike in terms of active brain development. This would support grouping 9th-graders in the high school and 5th-, 6th- and 7th-graders in a middle school.

Now, what do we do with the 8th-graders? Put them out to pasture? In terms of current organizational practice they will stay as the top grade in the middle school. This brings us to curriculum implications using Epstein's data.

2. Middle School Curriculum-

Epstein suggests that new intellectual challenges be given to children during brain growth spurts, these spurts corresponding to the Piagetian stages of intellectual development. During the plateaus, especially during the ages of 12 to 14, the middle school curriculum should be expanded to include more exploratory investigations and remedial skill development than moving students ahead toward college preparatory studies. This comment by Epstein reflects on the concern that many students do not have adequate skill development in reading and mathematics.

Epstein also suggests that,

> The child should be exposed to large amounts of information, and to a wide variety of experiences with nature, science, mathematics, people and work, the arts, enlarging the direct experience base and avoiding the pressure for elaborate inferences about the natures and interrelationsnips of such experiences. Furthermore, the plateau periods would be a time for perfecting the long neglected memorization skill involved in the learning of poetry and songs, of important facts of history, the facts of geography of the nation and the earth, of health science facts, of legal facts, of citizenship facts, etc. During these periods we could also help children increase their skills in already initiated competencies, especially in reading and mathematics.

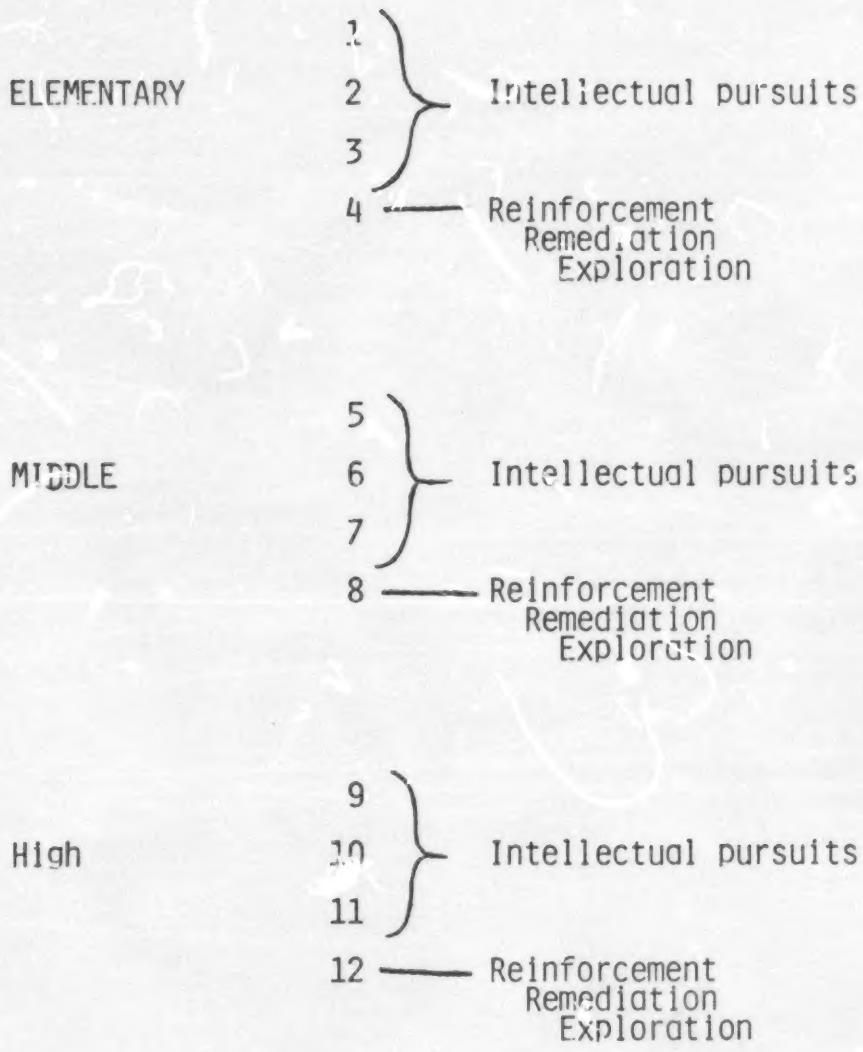
What we see developing is a total school organization something like this. [Transparency 5 here] The elementary school would consist of grades 1 to 4, three years of active intellectual challenge, followed by a period of skill reinforcement. Likewise, the middle school would consist of three levels of active intellectual challenge followed again by a period of exploration, skill development and remediation. The high school would also follow a similar pattern.

In essence, Epstein's work has asked us to once again look at the nature of our students, with particular emphasis on the early adolescent, and to develop a better rationale, not only for school organization, but also for our present curricula and instructional strategies.

Another exciting study concerns the relationships between the cognitive preference orientation and personality types of eighth-grade science students (Novak, 1980).

Transparency 5

SCHOOL ORGANIZATION



Robert W. Heath (1964) of the Educational Testing Service, suggesting that students would display different cognitive preferences as a result of curriculum treatment, developed the first cognitive preference test. [Transparency 6 here] This example is illustrative of the items found on a cognitive preference test (Atwood, 1971). Each item has a stem followed by three choices. At first glance, this looks like the typical item on any multiple choice test, but there is a fundamental difference: all choices are correct!

Students are asked to pick the answer from each item that they "like best" or "prefer." Using this example, a student who selects letter "a" would receive a point for memory, since letter "a" represents a preference for the recall or restatement of information in the stem. Students who select letter "b" would receive a point for application, since this choice represents an application of information in the stem. Finally, a student who selects letter "c" would receive a point for questioning, that is, the challenging or questioning of information in the stem of the item.

Students are classified as having a definite cognitive preference orientation if they select a majority of either memory, application or questioning choices. [Transparency 7 here] "M" students are those who accept information for its own sake; "A" students are those who prefer information in view of its applicability; and "Q" students prefer to challenge or question information.

Transparency 6

COGNITIVE PREFERENCE TEST ITEM

All stars are thought to be gigantic nuclear reactors.

a. The sun is the star nearest the earth.

b. The sun and other stars provide heat and light for the earth and other planets.

c. There are differences among stars.

Transparency 7

COGNITIVE PREFERENCE ORIENTATION

MEMORY (M) : accepts information for its own sake, with no consideration for its implications, applications or limitations.

APPLICATION (A) : accepts information in view of its practicability and applicability in a general, social or scientific context.

QUESTIONING (Q) : critical questioning or challenging of information as to its completeness, general validity or limitations.

There is strong evidence in the literature that cognitive preference orientation, that is, the way a student prefers to attend to subject matter, is influenced by curriculum and teaching behavior (Marks, 1967; Tamir, 1975). Students in traditional classrooms, characterized by fact-centered, direct teaching behaviors, select more memory choices than application/questioning choices. Students in inquiry programs, which are characterized by open, indirect teaching behaviors, select more application/questioning choices than memory choices.

Cognitive preference tests are invariably given to high school and college students, after they have completed a particular course of study. This is so because the student must be familiar with the content on the test. The underlying premise of cognitive preference testing is that students will prefer to use or respond to known information in a certain manner.

Many students who take inquiry-oriented programs in high school find them intellectually stimulating from the beginning. Others, we find, adapt to them, while others are totally frustrated by them, and oftentimes "drop the course," or worse, fail it.

Students are usually placed into these programs on the basis of their middle/junior high school performance: IQ test scores, letter achievement grades, and standardized test scores, oftentimes supplemented by teacher/counselor recommendations. It should be noted that many school systems no longer use or give IQ tests. Letter achievement grades are being replaced

by reports, indicating that students have or have not met certain teacher-prepared objectives. Standardized science tests are usually not given to middle/junior high school students.

Therefore, we asked if students in the eighth-grade, the traditional end of the middle school, have developed a cognitive preference orientation, and if this information could be used:

1. to better characterize them, and
2. to help place them in cognitively congruent high school programs.

[Transparency 8 here] These are the results obtained from 278 eighth-grade science students. As you can see, 14 students are classified as M, 34 as A and 10 as Q. Note that a cognitive preference orientation could not be determined for 220 students. These students did not select a majority of M, A or Q choices on the cognitive preference test.

It is rather surprising that in all the cognitive preference research studies reviewed, only definite preferences were considered. The NP's were never mentioned. We strongly suspect that they are in some statistical limbo. Novak (1980) confesses that he too placed his NP's into that same statistical limbo during his study, but we feel that we cannot neglect them from this discussion with you. After all, they are living, breathing students!

We postulate that three types of eighth-grade students may be identified based on cognitive preference orientation: [Transparency 9 here]

Transparency 8

COGNITIVE PREFERENCE ORIENTATION OF EIGHTH-GRADE SCIENCE STUDENTS

Cognitive Preference Orientation	N	%
M	14	5.0
A	34	12.3
Q	10	3.6
NP	220	79.1
	278	100.0

M- prefers recall of information

A- prefers information in view of its applicability

Q- prefers to question or challenge information

NP- no detectable cognitive preference orientation

Transparency 9

TYPES OF STUDENTS BASED ON THEIR

COGNITIVE PREFERENCE ORIENTATION

Traditionalists-	M,	MA,	MQ
NATURAL INQUIERS-	A,	Q,	AQ
UNDECIDED-	NP		

M- accepts information for its own sake, with no consideration for its implications, application or limitations

A- accepts information in view of its practicability and applicability in a general, social or scientific context

Q- critical questioning of information as to its completeness, general validity or limitations

NP- no detectable cognitive preference orientation

1. Traditionalists-

These are students who exhibit either a strong memory (M) cognitive preference orientation or a strong memory (M) orientation in combination with either application (A) or questioning (Q). These students prefer the recall of information, enjoy memory work and may resist an inquiry approach. They may be served best by a traditional approach to teaching, which, by the way, we suspect most teachers do teach.

2. Natural Inquirers-

These are students who exhibit a questioning (Q) and application (A) cognitive preference orientation. These students may already be "inquiry-minded" and find inquiry approaches the natural way to learn. They may also find traditional approaches somewhat tedious.

3. and, for lack of a better term, the Undecided-

These are students who do not exhibit a particular cognitive preference orientation. These students are probably in the majority in most classrooms, and who are the most influenced by a particular curriculum and teaching style associated with it. We suggest that they may become inquirers, explorers, if they are taught by a teacher who is inquiry-oriented. They may also be influenced toward traditional learning by a traditional learning approach.

If we look at cognitive preference orientation as a preferred learning style, then we have among eighth-graders traditional learners, inquiry learners and those who may have the potential to develop either style.

After reading a report by the Research Council of the National Academy of Sciences, we strongly suspect that we may be influencing the majority of our middle school students to adopt the traditional learning approach. In The State of School Science (1979), the Research Council indicates that many school systems are making less use of inquiry-based curricula and teaching strategies, especially in science and mathematics. The current role of the student is to listen, read and memorize. Little or no emphasis is being placed on inquiry, hands-on, exploratory or laboratory activities.

The Research Council has stated:

> Teachers and principals are under pressure to allocate more and more instructional time to the kinds of achievement measured by [standardized and criterion-referenced] tests, and to neglect those aspects of student learning that are not so well measured by the tests. Principals and teachers who advocate learning through experience find little to sustain them in such an environment.

If one of the goals of science education is to produce scientifically literate, inquiry-oriented citizens, then we, as educators, must give sustenance to those "... principals and teachers who advocate learning through experiences." Such sustenance would come, in part, from on-going teacher and administrator in-service, and studies to better characterize our students.

The next area we would like to discuss is the extension of the early adolescent's thinking to global problems. Baumrind (1978, p. 39), in a report by the National Science Foundation on early adolescence, states it thusly: The early adolescent

is "Newly awakened to the imperfection and hypocrisy of the adult world."

It is difficult to place this kind of thinking into either the cognitive or affective domains. Rather, it is like a bridge linking cognitive and affective, or it can be an affective situation which leads to cognitive development. It is during this period in the students' lives when they are gradually weaning themselves from parental control and becoming more aware of societal problems. They have concerns about energy and the environment, and feel that they can do something about them. They have other concerns such as starvation, poverty, war and disease, but in general do not feel they can do as much about these as they can about energy and environmental problems.

It is also true that these students are acutely aware of themselves: how they look ("I just can't go to school today! I have a pimple on my face!"); how they dress ("...but everybody is wearing tight jeans.") They are highly dependent on peer group acceptance and praise.

This leads us to further considerations of these students: their attitudes, values, and moral reasoning, that is, the affective.

C. Affective differences:

A recent National Assessment of Educational Progress (NAEP) publication addressed attitudes toward science and technology. The NAEP assessment program breaks down people

into four age levels and assesses at these levels: 9 years, 13 years, 17 years and young adults (ages 26-35).

It is generally agreed that science interest drops, sometimes dramatically, between elementary school and high school (Ayers and Price, 1975). The NAEP findings indicated 70% of the 9-year-olds had positive feelings about their science experiences in school, and 2/3 indicated they liked the idea of becoming a scientist. At age 13, the percentage drops to 50% for both!

When asked if science and technology have caused most, some, a few or none of our societal problems, 60% of the adults and 17-year-olds, and 46% of the 13-year-olds felt that science has caused most or some of today's problems. On the other hand, confidence in the ability of science to solve societal problems is fairly high: 58% of 13-year-olds, 63% of 17-year-olds and 65% of the adults think science will solve most of the nation's problems. About 75% of the 13-year-olds support the concept of applied research, as contrasted with basic research.

Research involving controversial issues showed that adults were less supportive than the adolescents. Asked if scientists should be allowed to create life, 46% of the adults said "definitely not" or "probably not" compared to 40% for 13-year-olds and 50% of the 17-year olds.

When asked: "Should scientists be allowed to do any kind of research they want to?," negative replies were given by 75% of the adults and 50% of both 13- and 17-year-olds.

Science interests, and the attitudes and values brought about by science and technology are important considerations in the science curriculum today and in the future. One very important finding by Science Service showed that many scientists chose science as a career during the middle/junior high school period of their lives. However, we are concerned not only with future scientists, but also with scientifically and technologically literate citizens. Their attitudes and values will play major roles in deciding on technological change.

The recent controversy involving molecular recombination, or "recombinant DNA," as it is popularly called, will serve as an illustration. In essence, recombinant DNA is a portion of bacterial DNA to which foreign DNA has been added. If, for example, the foreign DNA regulates insulin production, the bacterial population having been recombined for this characteristic would then produce insulin. Likewise, recombinant forms could be developed to produce a wide variety of biological materials or they could be used in cancer research.

Although microbiologists were at the peak of their investigations using recombinant DNA, they were literally stopped in their tracks because scientists (including many microbiologists) and citizens alike were concerned with the potentially serious societal consequences of such research. These consequences included:

1. the possible development of an "Andromeda Strain;
2. the creation of a Golem with a predetermined personality; and
3. by meddling with evolution, the creation of dangerous chimeras. (Davis, 1977)

Philip Handler (1977) has stated that, "Those who have inflammed the public imagination [over recombinant DNA] have raised fears that rest on no factual basis but their own science fiction." Whether or not the fears of those who have advocated stringent regulations or a complete ban on recombinant DNA research are based on fact or fiction, the attitudes and values of these individuals have had a major impact on such research.

Another short illustration might be the case for nuclear power. Will society accept it? Can middle school children, many of whom will be in their last science class, look at data and use it to help them make an important decision as to whether they would support nuclear energy as a source of electrical power? Again, the attitudes and values of these students will be a major factor in such decision-making.

Another important aspect concerning middle school students is that of moral reasoning. It is probably in a state of flux, and unfortunately, we may not know enough about it.

When asked about such things as cheating on an exam, some students will say, "It's OK, as long as you don't get caught;" to, "It's wrong!" - the law and order idea; to, "It's OK to cheat because tests are unjustified and teachers are wrong to give them."

Such reasoning could apply to our current energy problem. Look at the following example: [Transparency 10 here]

It is morally right to produce alcohol from excess grain crops rather than sending it to a country where people are starving.

Arguments can be raised such as:

a. We are right because we will prolong the agony: they are going to starve sooner or later.

b. We are right because birth control is not practiced in these countries, and food will increase the population problem.

c. Wrong; because it does not make Americans conserve fuels.

d. Wrong; because, if we as Americans eat more grain, instead of producing beef, we could have enough food for the whole world.

Early adolescents are also greatly affected by the attitudes and values of their peers, then by parents, followed by teachers. Most middle school children "go along" with the attitudes of their peers.

Mary Budd Rowe of the University of Florida has written, in our opinion, one of the best texts in science education for elementary and middle school teachers, titled, "Teaching Science as Continuous Inquiry: A Basic" (Rowe, 1978). Rowe has categorized students as either "crap shooters" or "bowlers." Thus, teachers are working with students who are taking chances - they are gambling on their education and trying to get by, to beat the game; taking chances on not being prepared; it's who you know and not what you know. Compare these students, the crap-shooters to the bowlers - those who are self-propelled, carry straight toward their goals and meticulously pursue them.

Transparency 10

M O R A L R E A S O N I N G P R O B L E M

in Eighth-grade Science Students

Statement: It is morally right to produce alcohol from excess grain crops rather than sending it to a country where people are starving.

a. We are right because we will prolong the agony; they are going to starve sooner or later.

b. We are right because birth control is not practiced in those countries, and food will increase the population problem.

c. Wrong; because it does not make Americans conserve fuel.

d. Wrong; because, if we as Americans eat more grain directly, instead of producing beef, we could have enough food for the whole world.

What kind of world faces these early adolescents? What kind of future do the bowlers and crap shooters have? What kinds of decisions will students, the memorizers, appliers and questioners, have to make?

Forecasting the future is a hazardous business. However, it is predicted that these students will face a future with the following characteristics:

-rapid advances in technology
-shortages of fossill fuels
-concerns about bioethics, pollution, genetic counseling
-shorter work weeks and more leisure time
-increased crowding on the planet
-hunger
-continued pressures for equality
-increased demands from less developed countries
-reduced pay and government debts
-a shift from a youth-oriented society to an older and more mature population.

What are some implications for curriculum and instruction after examining some aspects of the nature of early adolescents and the world in which they will be living?

First, certainly individualization of instruction is a must! Yet, programs where there is a high degree of individualization are in difficulty. What is happening to the Intermediate Science Curriculum for middle school students? Will the new Individualized Science Instructional System go?

Paul DeHart Hurd (1978, p. 57) recently commented that some individuals have criticized schools which overemphasize individualized instruction for early adolescents since it "...minimizes the responsibility of the teacher and neglects the value of systematic learning." Similar comments have been given to us by teachers who are unhappy using ISCS.

We personally feel that individualization is a must! Perhaps we need more creative efforts at individualization and a sound base to promulgate it to our teachers and administrators. One step in this direction may be another finding from Novak's recent research study (Novak, 1980).

Carl Jung (1973) has postulated that individuals perceive, or take in information by one of two methods: sensing or intuition. Sensing is the familiar mode of taking in information using the five senses. A preference for sensing leads to skills in observation, and to an interest in that which is real, tangible and factual.

Intuition is indirect perception by way of the unconscious. We are sure that most of you here today are familiar with the female's "sixth-sense," the gentlemanly "hunch" or the "inspiration," devine or otherwise, characteristic of intuitive perception. Intuitives often see the possibilities beyond the observable, are interested in discovering patterns and relationships from events, tend to be imaginative, and oftentimes tend to become theory-minded. "I see what you mean," is a statement of intuitive perception.

[Transparency 11 here] Novak found that 64% of the eighth-grade science students in his study were sensing and 35% were intuitive. It is interesting that 64% of a sample of eighth-grade mathematics' students were sensing and 35% were intuitive. These mathematics' students were tested in 1970, in a Florida junior High School by Daryle Cline May.

Both May (1971) and Novak suggest that sensing and intuitive students may need different forms of instruction.

Transparency 11

Modes of Perception in Eighth-Grade Students

	Science (Novak)		Mathematics (May)	
Sensing	174	64%	192	65%
Intuition	97	36%	103	35%
	271	100%	295	100%

Sensing: would rather work with known facts than look for possibilities, relationships and inferred meanings

Intuition: would rather look for possibilities, relationships and inferred meanings than work with known facts

Voss (1980) tells of a system he used during his junior high teaching days, namely, supervised instruction. There were six class periods per day, each period sixty minutes long. At least twenty minutes of each class period had to be spent with students. helping them with their assignments, etc. Dr. Voss and I feel that this was time well spent on indiviudal problems.

Most creative middle schools also have flexible time arrangments. There are activity periods where students can explore a host of interest areas from basket weaving and creative cooking to photography and machine repairs. In Ann Arbor, one middle school is using the small house concept. One hundred students are placed under a counselor, a house leader and four teachers - English, mathematics, social studies and science. Block time activities are scheduled easily, such as science field trips. Also, there is ample opportunity to work on multidisciplinary, teacher-prepared, curriculum projects.

Paul DeHart Hurd indicates that the new middle school curriculum will be societal rather than discipline-based. Subject matter will be interdisciplinary and selected for its general usefulness to life and living, rather than displaying the scientific nature of the disciplines. Process skills would be developed as much or more so in decision-making as in fostering inquiry. There will also be consideration of values in the science classroom. In addition, curriculum resources must extend beyond the four

walls of the classroom, including museums, industry, school camps, out-of-door studies and the like. (Hurd, 1978)

Our middle school students like to do things in science, but they are more interested in science, at say, the naturalist level than at the level of a research scientist.

Some present curriculum materials that may have a broader approval for the middle school are the Human Sciences Program, People and Technology and You and Your Environment.

These concerns clearly call for the rethinking of most of our programs in middle schools. It is time we begin to look at some of the specifics of middle school practice and at the nature of our middle school students, and then determine specifically what we can do to improve the education of a group that many would like to forget, but cannot, and must not be forgotten!

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